Vermont's Clean Energy Future:
Building climate change policy from the voices of Vermonters

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Executive Summary

A comprehensive study done by the Council on the Future of Vermont (CFV) from 2007-2009 determined that state residents rank alternative and renewable energy issues as one of the top five most important issues in the state of Vermont, with 56% of poll respondents claiming they were "very concerned" about Vermont's energy future (Moser *et al*., 15). The CFV compiled these data after interviewing over 3,900 Vermont constituents, with the goal of engaging citizens to discuss a common theme: the future of Vermont. This two-year project was intended to serve as a statewide dialogue and to learn from Vermonters about their "hopes, aspirations and visions for the future of the state," with the ultimate goal of gleaning a set of values that are common to the Vermont identity. CFV's final report, titled *Imaging Vermont: Values and Vision for the Future*, clearly highlights Vermonters' concerns pertaining to the state's energy future while also highlighting their demand for the benefits of a low carbon economy.

This report broadly focuses on Vermont's energy future in the context of climate change and considers the feasibility of adopting a market-based, carbon abatement policy, such as cap-and-trade and carbon tax mechanisms, within the state. The goal of this report is to illustrate how the benefits of these policies can align with the values of Vermonters and address many of the energy issues specific to the state. Through our research of current cap-and-trade and carbon tax policies in North America, Europe and Australia, we have built a policy recommendation that is tailored to Vermont's unique emissions portfolio, as well as to Vermonters' priorities and concerns. Overall, this report evaluates why Vermont may be uniquely positioned to take leadership in the fight against climate change and serve as a model for other states in the country.




"I believe there is no greater challenge and opportunity for Vermont and our world than the challenge to change the way we use and produce energy. The challenge is not unique to Vermont, but Vermont does have a tremendous opportunity to serve as a leader. The way we use and produce our energy will help our economy, our energy security and independence, and our environment." *—Governor Peter Shumlin*

I. Climate Change in Vermont

In August 2011, Tropical Storm Irene swept north from the Caribbean and left extensive damage along the eastern coast of the United States in its wake. Although forewarned of the imminent storm, land-locked Vermont was shocked by Irene's strength as the state was pummeled by seven to eleven inches of rain and 100 mile-per-hour winds over the course of two days. To make matters worse, this hurricane came on the heels of one of the rainiest summers on record in Vermont. Rivers flooded drastically throughout the state and destroyed bridges, roadways, mountain passes, and homes. The extensive damage ultimately disturbed 225 municipalities from the Mad River valley south to the Deerfield River (Pealer, 1). In fact, water levels reached those of the 1927 historic flood, which for 83 years had set a record. According to the Vermont Agency of Natural Resources, "the devastation sent the state into disaster mode, and to date, the storm's effects are still being realized" (Pealer, 1).

The storm physically demonstrated the power of climate change to inflict real changes to the environment, and it viscerally demonstrated the sense of vulnerability and powerlessness associated with enduring these impacts. As expected, this drastic event triggered the state of Vermont to seriously question its progress on combating climate change—an irrefutable reality for the state, country, and world. Deb Markowitz, Secretary of the Vermont Agency of Natural Resources, stated in an interview, "climate change is at the forefront of Vermont's agenda right now, after the massive destruction of Irene." Data indicate that Vermont is experiencing more extreme weather events and a warming climate (Pealer, 1). Since 1970, average temperatures in the Northeast have risen 2°F, with winters warming even more rapidly—4°F during that time (EPA, "Climate Impacts in the Northeast").

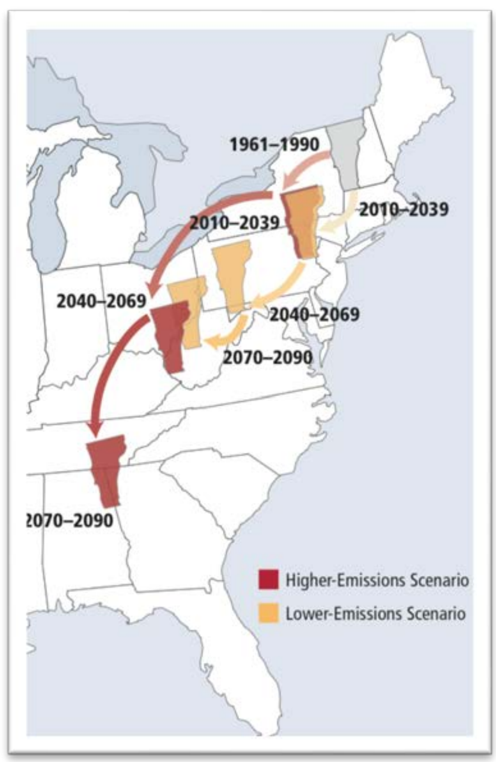

Figure 1. Changes in average summer heat index expected in VT over the next 100 years. http://www.climatechoices.org

Climate change presents a particular threat to the

natural resources and ecosystems that make Vermont unique. The region's distinct seasons support local businesses such as maple sugar producers, and create the green mountains of summer and vibrant foliage of autumn for which Vermont is celebrated. Snow is also an iconic aspect of Vermont, and milder winters pose a challenge to Vermont's winter sport businesses. In 2010, the northeast experienced the fourth-warmest winter on record since 1896, during which half of the nation's ski areas opened late and almost half closed early (Seelye, 1). Certain warming scenarios predict that more than half of the 103 ski resorts in the Northeast "will not be able to maintain a 100-day season by 2039," according to a study performed at University of Waterloo in Ontario (Seelye, 1). The sustainability of the state's landscape, economy, and character depend on a global emission reduction. Governor Shumlin, while speaking on the importance of fighting greenhouse emissions, said "Climate impacts in Vermont include the loss of our hardwood trees including Sugar Maples, the spread of insect pests impacting our forests, waters and public health, and increased soil erosion. I am committed to aggressively fighting interstate air pollution and climate change"(Pealer, 5). Overall, if Vermont does not take steps to abate emissions, the state can expect to experience drastic changes in climate over the course of this century. It has become clear through events such as Irene that the time is now to slow the rate of climate change. The emissions decisions of today—in Vermont, the Northeast, and worldwide—will determine the next generation's climate, economy, and quality of life. Barbarina Hayerdahl, an activist engaged in climate change and a resident of Shelburne, put it concisely: "We clearly need massive change, and we needed it yesterday."

II. The Carbon Problem

The Problem

The problem facing Vermont is in fact part of a much greater problem that plagues the nation as a whole: carbon is not valued. This issue is deeply imbedded in our political and economic structure. Simply put, the prices of fossil fuels do not reflect their full costs, which disadvantages the development of renewable energy and efficiency measures. The lack of a proper price signal explains why the nation has not taken major strides toward transitioning away from fossil fuels and toward less carbon-intensive energy resources.

This idea of "true cost" can be explained by a simple example. Imagine an industrialist or businessman purchases electricity from a coal fired power plant. He purchases power at a rate of $0.10/kWh in order to produce a product for sale. This $0.10/kWh rate is classified as a *private cost*—an input cost incurred by the businessman in order to produce specific goods. There are, however, other costs associated with this transaction. The combustion of coal produces particulates, NO_x and SO_x, and CO_2, for example, all of which impose costs upon society in the form of asthma and other respiratory ailments, acid rain and global warming. These costs imposed on society as a result of coal combustion are what we call *social costs*.

In economic terms, an externality exists in the above example because the industrialist is not held accountable for the entire cost of his power consumption. Externalities exist in instances where two parties engage in a market transaction where a third party is positively or negatively affected and remains uncompensated. In this above example, the industrialist and the power plant engage in a market transaction where a third party (society) is negatively impacted by particulates and CO_2, for example, and remains uncompensated. In the absence of public intervention, the industrialist and the power plant are only concerned with the private costs associated with their transaction and have no incentive to compensate the public for the social

costs they are imposing upon them. Arthur Cecil Pigou, in his book *The Economics of Welfare*, was the first economist to make this critical distinction between social and private costs in the context of externalities. Pigou's great contribution to economics was not only the identification and analysis of this problem through the lens of *private* and *social costs*, but also his solution to this instance of market failure.

Carbon Tax (Pigouvian Solution)

If we were to say that society incurs $0.03 of medical and environmental costs for every kWh produced from coal, then Pigou suggests a tax should be levied equal to $0.03/kWh. As a result the consumer pays $0.13/kWh (social + private cost); the power plant receives $0.10/kWh (private cost); and the individuals adversely affected by the coal combustion are compensated at a rate of $0.03/kWh (social cost). A carbon tax—also known as a Pigouvian tax—is exactly what Pigou initially proposes: a tax on a specific pollutant. A carbon tax assigns a social cost to carbon and levies a tax on human emissions equal to the determined social cost. With a price attached to carbon, suddenly, individuals are faced with a strong incentive to limit their carbon emissions. Individuals still have the right to pollute, but are required to pay the government in order to do so. The proceeds or revenue collected from carbon taxes have been used in a myriad of different ways (See Appendix B: Examples of Market-Based Carbon Abatement Mechanisms, for a description of current carbon tax policy and modern day revenue distribution).

Cap-and-Trade Solution

Thomas Crocker (1966) and John Dales (1968) introduced the idea of capping emissions rather than taxing them. Also known as cap-and-trade, this type of quantity capping mechanism either allocates or auctions permits to pollution producers in a region (See Appendix A: Theoretical Framework, *Allocation vs. Auction*). In the context of carbon, each permit corresponds to one ton of CO_2 and the total number of permits equals the maximum amount of possible carbon emissions. These permits can be freely traded and have value because only the producers that own permits can pollute. A producer with modest pollution requirements can sell excess permits on the secondary market to a producer with higher pollution requirements (Hanley *et al*., 87) (See Appendix B: Examples of Market-Based Carbon Abatement Mechanisms for description of modern day cap-and-trade programs). This type of quantity capping mechanism incentivizes emissions reduction because firms that effectively abate carbon can save money and sell excess permits on the secondary market. Firms that avoid carbon abatement are required to incur carbon related expenses by purchasing carbon permits that directly correspond to their total emissions.

To summarize, a cap-and-trade mechanism places a quantity restriction on pollution by issuing permits. Each permit corresponds to a ton of pollution. Market forces determine the price of each permit, and polluters can freely trade permits on the market. In contrast, a carbon tax places a cap on price by assigning a monetary value to a ton of pollution. As a result, the market determines the quantity of pollution emitted. An easy way to remember the difference between cap-and-trade and a carbon tax is that the former caps quantity while the latter caps price.

Cost-Effective Nature of Solutions

Both carbon taxes and cap-and-trade are considered cost-effective because they minimize expenses associated with carbon abatement. These mechanisms provide the least cost path towards carbon emission reduction, which strongly contrasts with other methods of pollution

reduction, such as Command and Control policies or Renewable Portfolio Standards. Conceptually, this proposition is not difficult or controversial to justify: pollution producers are faced with different costs associated with controlling emissions. Producers that can inexpensively reduce emissions do so, because it is cheaper than purchasing a permit or paying an incremental tax. Firms faced with higher carbon abatement costs will most likely take the cheaper route of purchasing permits or paying the incremental tax on carbon. Generally, firms will reduce emissions up until the incremental cost of carbon abatement equals the additional cost of a carbon permit or carbon tax (Tietenberg, 16; Hanley *et al.*, 61). Most importantly, both cap-and-trade and carbon taxes encourage individual firms to pursue the cheapest strategy of carbon abatement (See Appendix A: Theoretical Framework, *Tietenberg and Hanley on Cost-Effective Pollution Control.* Additionally, see *Definitive Emissions Reduction* and *Price Volatility* for further discussion on the intricacies of these mechanisms).

The power of these mechanisms and their ability to cost-effectively reduce carbon emissions is a critical concept to understand, especially when comparing these policies to other forms of non-market-based pollution control. The following section details why Vermonters demand these cost-effective mechanisms and why the state's constituents value the benefits of a low carbon economy (See Appendix A: Theoretical Framework, *Alternatives to Market-Based Abatement Mechanisms*).

III. The Voices of Vermonters

VCRD and the Council on the Future of Vermont

Climate change poses a risk to Vermont, just as it does to most other parts of the world. The next logical question is how Vermonters perceive climate change, particularly in comparison to the wide-range of other economic, social and environmental problems on the state's agenda. The importance of documenting Vermont's long-term priorities came to the attention of the Vermont Council on Rural Development (VCRD), when the question, "what is our vision as a state?" arose repeatedly in discussions. VCRD is a non-partisan, non-profit organization, founded in 1992, with the mission of aiding Vermont communities to "develop their capacity to create a prosperous and sustainable future" through collaboration with federal, state, local, non-profit and private partners. The organization hopes to engage and unite Vermonters, and to research, develop and advance policies that "support Vermont's quality of life while promoting economic opportunity" (VCRD, "About VCRD"). VCRD often convenes policy councils to provide forums for in-depth study of specific issues and draft concrete policy recommendations.

What common values do Vermonters share?

- "Protecting the **landscape**. Building a locally self-reliant state economy based on sustainable agriculture and sustainable energy production." *–Dummerston*
- "**Strong community**, and sustainable use of our land." *–Burlington*
- "A love of the landscape, open spaces, green spaces and plenty of trees and relatively undisturbed habitats. **Participatory democracy** is important to us. We like to have feedback and the opportunity to talk to department heads and elected representatives at every level." *–Brattleboro*
- "An appreciation for the beauty of the state, the **natural resources and working landscape**, the smallness, and the community." *–Wallingford*

In 2007, VCRD created the Council on the Future of Vermont (CFV) as a way to engage citizens in a conversation about how they envision Vermont in the times ahead (VCRD, "Imagining Vermont", 5). The two-year project intended to serve as a statewide public dialogue

to learn from Vermonters about their "hopes, aspirations and visions for the future of the state," with the ultimate goal of gleaning a set of values that are common to the Vermont identity. The process included two years of research, public forums, testimony from statewide organizations, and the polling of Vermonters from various demographics. The Council held focus groups with nurses, farmers, teachers, veterans, inmates, low-income Vermonters, and business leaders, to name just a few. In total, over 3,900 Vermonters contributed their ideas to this process. Their answers give insight into the prevailing values and concerns that Vermonters consider important in their daily lives in 2007 and beyond. The comprehensive findings of the Council were published in a report titled, *Imaging Vermont: Values and Vision for the Future.*

Working Lands Enterprise Initiative

The CFV collected more comments about the environment, nature, farms, and working lands than any other topic. This common theme indicates "connection to the land is an identifying element for Vermonters." In fact, the highest ranked value from the polls was the statement: "I value the working landscape and its heritage" (VCRD, "Imagining Vermont", 12). Vermonters are overwhelmingly united in support of the "Working Landscape," which includes agriculture, forestry, and other natural resource-based economic sectors. Vermonters highly prioritize the protection of the working landscape, as it is the "backbone of Vermont's heritage and economic viability" and resonates with their love of outdoor recreation, closeness to nature, and the beauty of the state (Vermont Government, "Working Lands Enterprise Initiative"). Many Vermonters expressed their concerns about threats to agriculture and the forest industry, which are essential to Vermont's character and economy. In direct response to this concern, the CFV and VCRD established the Working Landscape Initiative (WLI). The WLI wrote bill H.498, which passed in 2012 as Act 142, the Working Lands Enterprise Initiative (Vermont Government, "Working Lands Enterprise Initiative"). This program allocates over one million dollars annually to fund entrepreneurial agriculture and forestry businesses and stimulate the working landscape economy of Vermont. The first point in Act 142 states the CFV's finding that 97% of Vermonters value and support the working landscape, and continues to emphasize how the legislation coincides with the ideals of Vermonters. This highlights the power of quantifying and demonstrating the public's priorities in passing legislative bills. Moreover, this bill was passed in a political moment when little else was accomplished in the legislature and state funds were tight, which indicates the capacity of civil dialogue and public participation to spur change in times of political gridlock (Costello). Legislation that directly aligns with the values and priorities of Vermonters clearly can succeed. The approval of the WLEI policy and budget may serve as a model for how to mobilize action around other priorities garnered from the CFV, such as the desire for clean and renewable energy.

June 2013—over $1M awarded to 36 Vermont "Working Lands Enterprise Fund" recipients

Selected profiles of grant awardees (Working Lands, 2013)

- **Vermont Cranberry Company**, *Franklin County*

  $15,000 for "Capital for press building, freezer space and a solar drying facility to increase production of cranberry juice and dried cranberries"

- **Vermont Wood Manufacturers Association**, *Rutland*, Statewide Impact

  $48,000 for Workforce Development for the Secondary Wood Manufacturing Industry

- **Jasper Hill Farm**, *Orleans County*

  $50,000 for a Cheese Microbiology Lab to Develop "Artisanal Cultures" to Promote Product Quality and Safety for Vermont Producers

The Demand for Clean and Renewable Energy

Vermonters today are also deeply concerned about the state's energy future. Energy was ranked as one of the top five most important priorities for Vermont, and included alternative/renewable energy, increased efficiency/lower consumption, and energy independence. 56% of poll respondents reported that they were "very concerned" about Vermont's renewable and alternative energy infrastructure (Moser *et al*., 15). Because of its dispersed populations and limited public transportation systems, Vermont is highly dependent on imported fuels for heating and transportation, which raises their susceptibility to fluctuating oil prices. Vermont energy use has been rising faster than the national average, and the availability of low cost oil will inevitably decline. Responses to the polls indicate that Vermonters are increasingly concerned about the state's growing carbon emissions, as well as the increasing portion of their family income that leaves the state and country through energy consumption to benefit "unfriendly foreign regimes" (VCRD, "Imagining Vermont", 16). As a result, many believe that Vermont should take the opportunity to find new solutions to the energy problem. They expressed that they look to the state for leadership in achieving clean, renewable, reliable, and cost-effective energy. In public testimony, Vermonters emphasized that local, sustainable, sources should be expanded to create jobs, advance energy independence, and secure long-term, affordable, energy in the state. Many also indicated that they are personally conscientious about energy use and want to maximize energy efficiency and conservation (VCRD, "Imagining Vermont", 12).

What should our priorities be in Vermont?

- "The number one priority is how do we make our state attractive to **clean, green, and Vermont friendly business** that support our progressive and socially responsible ideas." *–Rutland*
- "We should look at where our energy comes from and be at the forefront of using **decentralized, not-polluting energy sources**: wind, solar, hydro, biomass, geothermal." *–Brattleboro*
- "To be an example of **sustainable living**, reducing the gap between rich and poor, pushing forward on renewable energy and alternative transportation." *– Montpelier*
- "**Clean energy and tax incentives** for homeowners and businesses to install solar and wind power." *–Manchester*
- "Alternative energy should be the focus for our **jobs growth**." *–Montpelier*

Vermonters care deeply about the long-term sustainability of their economy and environment, which has generated a sense of urgency around reducing their reliance on fossil fuels. When prompted about next steps, the primary polling response was increased funding for alternatives and efficiency. In their comments, many Vermonters called for advanced energy efficiency, energy independence, and clean, renewable, local, power, all of which Vermonters hope will benefit local economies and grow the statewide green economy. Vermont already laid the groundwork for meeting these demands. The state has developed many local and renewable alternatives to fossil fuel-based energy, and weatherized thousands of low-income homes, yet this progress must occur on a much larger scale to achieve a significant dent in emissions. Vermonters believe the state government should lead the way in improving energy efficiency and expanding renewable energy generation for use in homes and businesses. This political process may be difficult, especially in the context of budgeting. "The only missing ingredient to achieving our goal of thermal efficiency is revenue," stated State Legislator Tony Klein at the 2013 Renewable Energy Vermont Conference.

Concerns and Conflicts

The CFV dialogue found that two major priorities—in addition to the environment and energy—were improving affordability and the economy. Vermonters indicated high concern for the economy, jobs, and increasing cost of living—82% stated they were very concerned (Moser *et al*., 18). When asked*: What do you see as the most important goal for Vermont in the next generation?*, responders primarily stated issues related to affordability, including tax rates, affordable healthcare, education, and the need for more jobs and higher wages. Ninety-six percent of respondents reported being either very or moderately concerned about the increasing costs of transportation, heating and electricity (Moser *et al*., 35). These concerns demonstrate that "items viewed as necessities are becoming out of reach for individuals and families earning average wages, not just in Vermont but across the nation" (VCRD, "Imagining Vermont," 7). Vermont is home to an income gap much lower than the national average, but it has grown in recent years and threatens to divide its cherished small-scale communities. In terms of the economy's viability as a whole, many Vermonters emphasized the need to advance businesses and jobs, attract young people, reduce restrictions to facilitate the growth of new businesses, and develop green industry. Many Vermonters value small government, individual freedoms and self-reliance, and expressed concern for the tax rate in Vermont (84% were very or moderately concerned) (Moser *et al*., 37).

What Challenges Do We See?

- "Keeping **food on the table** is hard. The economy needs more help." *–West Bridgewater*
- "Attracting and supporting **new businesses** to maintain and grow the job market to provide young people and families the choice to stay and live in this great state without having to expect less." *–Middlebury*
- "Keeping **young bright minds** in the state by encouraging the growth of businesses and organizations that work on global issues." *–Burlington*
- "**Taxes** and government to a minimum, encourage growth within the state. Fight against federal spending." *–Shaftsbury*
- "**Energy prices** will continue to rise as demand outstrips supply, pressuring the economy, impacting jobs, resulting in continued price rises in food and other necessities." *–Essex*

At first glance, it would appear that Vermonters' priorities to boost the economy and improve affordability may conflict with their call to reduce fossil fuel reliance and develop local, renewable, energy alternatives. Pollution regulations are often believed to weaken the competitiveness of existing businesses and discourage the arrival of new businesses. Also, many Vermonters call for fewer taxes and regulations as a way to stimulate the economy. Tim Ashe frankly stated in an interview "the dollar value is what motivates most policies," and many Vermonters doubt the economic benefits of climate policy. Therefore, what the public must recognize are the social costs of carbon that are being incurred by Vermonters today due to a warming climate—including damages to human health and increased flood risk.

As a result, an innovative, well-planned energy policy designed specifically for Vermont could in fact meet the demand for clean energy while also achieving the overarching goal of improving the economy. A carbon tax, for example, could generate revenue to invest in energy efficiency and renewable energy infrastructure. This investment will generate savings now and in the future, given that the oil that Vermonters depend on for their daily commute and winter heating is declining in quantity and increasing in price (VCRD, "Imagining Vermont," 12). Legislation will also provide clear benefits to low-income Vermonters, who can benefit from a dividend that will drive down heating and electricity costs. The state would greatly enhance its

energy security and reliability by advancing in-state renewable options, for an energy mix that is clean and economical in the long-term. Moreover, a carbon-pricing policy would stimulate economic development by promoting green businesses and attracting more clean energy jobs to a state that in 2012 ranked number one per capita in the green economy (DGA, "Vermont ranks #1 in Green Jobs"). Around 4.4% of Vermonters are already employed in the "green sector"—a sector that undoubtedly will grow with a renewed commitment to carbon regulation. Vermont businesses could become the experts on weatherization, electric vehicles, or net-metering, which would foster the innovation and growth that Vermonters directly called for to "keep young bright minds in the state." Envisioning Vermont's future, Paul Costello, Executive Director of VCRD, stated, "Vermont is not going to attract huge manufacturing in the near future. Instead, it could become the creative center of environmental development, for the young and old alike."

IV. Why Vermont?

While environmental trends facing the state are global in scope and severity, many residents assert that Vermont is uniquely positioned to take action on a state level. Certainly, as a territory with a mere 626,011 residents and a contribution of just 0.1% of the nation's total greenhouse gas emissions (U.S. Census Bureau), the transition to a low-carbon economy in the state alone would not significantly dent the carbon footprint of the nation, let alone the world. However, this report wishes to dispel the myth that carbon regulation in Vermont does not matter, and prove instead that the state has great potential and ability to take the lead on innovate climate policy.

As previously mentioned, the first reason why a carbon-pricing mechanism could work in this state is because residents deeply value the environment and wish to reduce their contribution to climate change. Second, two other common values found in the CFV are community ties and independence. Vermonters foster "a shared feeling of belonging, acceptance and trust; a sense that the success of each neighborhood, town, county, and the state depends on the contributions and engagement of every individual" (VCRD, "Imagining Vermont", 5). With more than half of adults engaging in active community service, Vermonters feel a shared responsibility to ensure the well-being of all people in the state, and of future generations. Their community-oriented lifestyle and emphasis on accountability indicate that Vermonters would be willing to contribute more for the common good and to work together toward a low-carbon future. Vermonters are also very proud of their spirit of independence, "both politically and as a way of life" (VCRD, "Imagining Vermont", 5). Vermont practices a variety of activities reflecting self-sufficiency, from the thousands of small businesses and local farms to the significant gardening culture. As champions of independence and self-reliance, Vermonters may be more willing than other states to spearhead new policies

Vermont's Role

- 93% of CFV poll respondents agree or strongly agree with the statement "I value Vermont's **spirit of Independence**" and "I am proud of being from or living in Vermont"
- "We need to become as **energy and food-independen**t as possible. This will ensure our security and will also make Vermont a uniquely attractive place to live, work, and invest." –*Burlington*
- "VT is **community oriented** and democratic. We figure out challenges and issues by talking to neighbors." –*Brattleboro*
- "Vermont means home, clean air, friendly people, no billboards, local products, a vibrant and participatory community. It also means **progressive views**, and a strong sense of equality, and social justice for all." – *Winooski*
- "Independence and cooperativeness and **interdependence**. Representatives are accessible so we tend to believe we have a right and obligation to speak up" –*Plainfield*

and take action for an issue that is important to the state as a whole.

Third, Vermont is small in population—ranking 49th out of 50 states—but its size is its greatest strength. What Vermont lacks in numbers it compensates for in action. Political will and public groundswell can enact rapid change. The citizenry routinely self-governs and votes in numbers which rank Vermont among the highest performing populations of all the states (Moser *et al*., 2). To tackle external challenges, Vermonters utilize self-reliance, creativity, and self-sufficiency, particularly in local energy solutions. When asked if Vermont is too small to make a difference in climate change, Darren Springer, Deputy Commissioner of the Vermont Department of Public Service, responded with a strong no, asserting "there is value in being innovative, there is value in policy experimentation, and there is value in Vermont expressing leadership." As a result, "many Vermonters see a huge opportunity for the state to do something new and innovative in clean energy generation because of the size, scale, and natural resources of the state" (VCRD, "Imagining Vermont", 19). Many political figures claim that Vermont needs to connect with surrounding states and implement a regional, instead of state-wide, carbon-pricing policy to minimize the political and economic risks. But, Betsy Taylor, President of Breakthrough Strategies & Solutions, calls this a "classic political cop-out." She believes that Vermont has the potential to move forward as a state. In its spirit of independence, many residents of the state do not value waiting for others to take action first. As Vermonters continue to understand the tangible economic and leadership benefits of a low carbon economy, Vermont can feasibly maneuver itself to the forefront of the nation's clean energy landscape. Vermont can lead by example and show that innovative energy legislation can provide economic growth and payback, despite the challenges associated with the political process. The amount of emissions that Vermont can reduce takes a backseat in importance to its ability to provide an economic and political model for other states to follow.

Lastly, the state's political will serves as the vital foundation for any action toward a greener economy. Vermont has the political leadership in place from Governor Peter Shumlin, cabinet officials and elected representatives, to a citizenry demanding clean energy and lower emissions, to create a model system of carbon pricing that benefits everyone in the state. Furthermore, Senator Bernie Sanders (I-VT) introduced an innovative carbon bill at the national stage in 2013, showing that the state is already at the cutting edge of carbon policy dialogue in Washington. Governor Shumlin has indicated his desire to avoid any new broad-based taxes, while also expressing an imperative to tackle the challenges raised by climate change. Many Vermonters echo this "no new taxes bandwagon" sentiment. Through creative and thoughtful policy development, however, both of these seemingly exclusive goals can be accomplished.

Vermonters have long perceived themselves as independent and community minded, with a concern for the common good, which has inspired them to do their part in leading action against climate change. Citizens across the state and across a wide range of demographics call for legislation to change the way Vermont uses and produces energy, and the leaders of the state have the power to step up to this challenge. The following sections discuss several components for a visionary greenhouse gas regulation and budgeting regime in Vermont that meets the demand of Vermonters while addressing their concerns for affordability and equity.

V. Energy in Vermont: The Current Picture

Energy Use and Supply

As demonstrated by the results of the Council on the Future of Vermont, citizens of the state called for power resources that are "clean, green, renewable, and economical as possible" to improve the energy independence and green economy of the state. This is a sizeable goal, but hope lies in the fact that Vermont is not starting from scratch on this issue. Vermont has one of the least carbon-emitting electric portfolios in the nation, but there still remains great room for improvement in advancing renewable energy and energy efficiency. Vermont primarily emits greenhouse gas emissions through the consumption of fossil fuels for transportation and heating, and progress on targeting these sectors is crucial (VCRD, "Imagining Vermont", 12). Hence, as part of Act 170, Vermont plans to source 90% of its energy across all sectors of the economy from renewable resources by 2050, and reduce the state's greenhouse gas emissions by 75% from 1990 levels by 2050 (VT Department of Public Service). The first step in moving Vermont toward these goals is taking a closer look at the current state of Vermont's energy usage and sources.

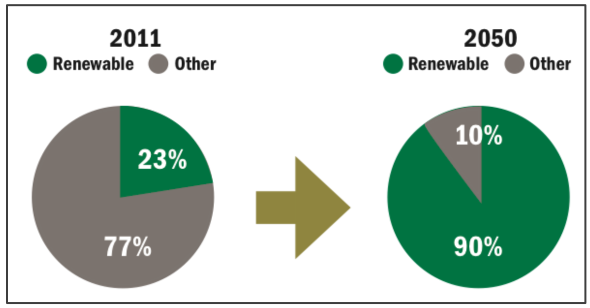

Figure 2. Vermont's renewable goal, as of 2011 (VDPS)

Hydroelectric

According to the Comprehensive Energy Plan, "Vermont currently obtains nearly a quarter of the energy it uses from renewable resources, due in large part to the fact that nearly half of [its] electricity is generated from renewable sources," primarily Hydro Quebec and NY Power Authority (VT DPS). In fact, twenty-three percent of Vermont's net electricity generation in 2011 was sourced from conventional hydroelectric power (EIA, "Vermont"). Vermont law defines "renewable energy" as "energy produced using a technology that relies on a resource that is being consumed at a harvest rate at or below its natural regeneration rate" (Powell). According to this definition, Vermont views hydropower as a renewable and reliable resource, given that it utilizes the earth's water cycle to generate electricity and does not pollute the air. Other states do not necessarily agree with this interpretation of "renewable," and often disqualify large-scale hydropower from contributing to their Renewable Portfolio Standards. Hydroelectric plants can exert negative impacts on the environment—including the habitats, river flows, and fish migration—yet these effects may seem minimal in comparison to the damage associated with coal, oil, and even natural gas. In fact, Vermont was the first state in the nation to treat electricity generated by large hydro facilities as a renewable resource, when Governor Jim Douglas signed H. 781 into law as Act 159 in 2010 (Powell). Given Vermont's favorable view of hydropower, the state approved a twenty-six year extension of energy trade with Hydro-Québec in 2011, replacing the previous 1987 contract. After the Public Service Board approved the 225-megawatt power-purchase agreement, Green Mountain Power President Mary Powell stated, "this approval ensures a large, clean, renewable baseload energy source in our portfolios that will be competitively priced and reliable" (Remsen). Vermont's decision to treat large hydropower as renewable energy will help the state reach its renewable energy goals in the coming years. Given

that large-scale hydroelectric development may contrast with Vermonters' value of the landscape and natural resources, the expansion of hydro will either come from out of state or from small, in-state capacity (VT DPS).

Nuclear

Forty percent of Vermont's electricity came from nuclear in 2011, but that portion dropped to 16% in 2012, as Vermont utilities no longer purchased from Vermont Yankee (VT DPS). That remaining 16% is committed through Green Mountain Power's contract with the Seabrook plant in New Hampshire and from Connecticut's Millstone 3 reactor, which is partially owned by Central Vermont Public Service (VT DPS). Vermont Yankee owner Entergy Corp. announced in August 2013 the impending shut down of the 41-year-old Vernon plant in 2014 (Hallenbeck and Johnson). The closing of the aging plant was influenced by the growth of cheap natural gas on the market that has reduced the cost of energy. "The absence of Vermont Yankee's 650 megawatts of power will have no adverse effect on the New England power grid," said Christopher Dutton, president and chief executive of Vermont Electric Power Co., which manages the state's electric transmission system (Hallenbeck and Johnson). But, the decision puts increased pressure on the state to develop more clean energy technologies, because nuclear power is considered zero-emission, and the grid is now more likely to rely on natural gas and other carbon-emitting fuels. Besides nuclear and hydroelectric, the remainder of the state's electricity comes from fossil fuel plants and other market sources outside of Vermont (VT DPS).

Dependency on Oil

Combined, the transportation and residential sectors make up two-thirds of the state's energy usage (EIA, "Vermont"). The sources vary, but one attribute they have in common is that almost all of the energy is imported from outside of Vermont (EIA, "Vermont"). The state relies on importing carbon-based fuel for the majority of its heat and transportation needs (VCRD, "Imagining Vermont," 101). Hence, nearly all of the dollars spent within those sectors fund the extraction of fossil fuels and ultimately end up out of state, and out of country. This is of great concern to Vermonters, who strive to keep their energy dollars in-state.

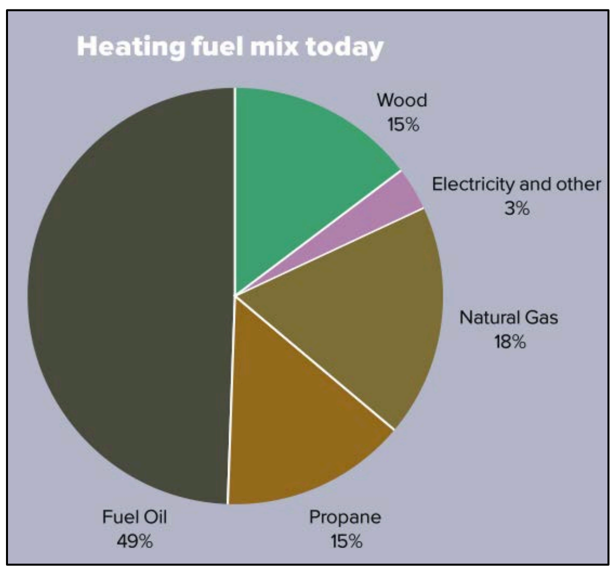

Figure 3. Vermont's Thermal Mix in 2011 (VPIRG)

Home and commercial heating—one third of Vermont's energy use—has an unusual energy mix compared to that of other states. Vermonters use more fuel oil, and less natural gas, to heat their households than the national average (VCRD, "Imagining Vermont," 102). According to the Vermont Public Interest Research and Education Fund, "Vermont needs a diverse thermal portfolio based on a clean and reliable fuel mix that can serve as a hedge against the impacts of regular price spikes in fuel oil costs" (VPIRG, "Vision & Action for Our Heating Future"). Vermont continues to heavily utilize heating oil, even though biomass and solar thermal systems have reduced fossil fuel

heating usage to some extent (VT DPS). Volatile fuel oil prices have caused home heating costs to rise at increasingly high rates in recent years. In the fall of 2008, they were at triple the rates of 1999 (CFV). In a climate that requires extensive home heating, the state also strives to improve its energy efficiency. According to VPIRG, "about 50 percent of the state's homes pre-date any energy efficiency standards for buildings and require more fuel to heat." Vermont has achieved total energy efficiency in 6,700 homes since 2008, but "the pace would have to increase to 8,200 homes *per year* to meet the legislative challenge to improve the energy performance of 80,000 homes by 2020" (VT DPS).

Energy Education

"Energy education is a priority – right now people aren't sure what they should do or how they should do it. But we need to change the bigger attitude and make it the Vermont way to not create waste."(CFV)

"People don't actually understand the cost equation of improving efficiency in their homes and businesses. They don't actually believe they will save money by installing some of these devices. A deep cultural shift is required so that people understand that they get real savings from these tools."
–Tim Ashe

For transportation—another third of the state's energy use—Vermont's dependence on imported fossil fuels is just as high, compared to national standards. Vermonters drive more miles per day than the national average, due to the rural character of the state, the lack of public transportation infrastructure, and the ensuing dependency on private automobiles (VCRD, "Imagining Vermont," 104). In fact, "on any given day, more than 98 percent of Vermonters ride in personal vehicles…at an average distance of 36 miles" (VCRD, "Imagining Vermont," 104). People are driving more cars more often, but the efficiency of the vehicles has not improved in the past two decades. Transportation costs typically rank second highest for VT households, after housing costs, and the combustion of its fuels accounts for 47% of the state's GHG emissions (VT DPS).

To address these challenges, the Vermont Agency of Transportation developed a Climate Action Plan in 2008 with recommendations for reducing GHG emissions from the transportation sector. The three approaches include promoting the development, availability, and use of cleaner burning bio-fuels, increasing vehicle efficiency, and increasing the efficiency of the transportation system (VAT, "Vision & Action for Our Heating Future"). In the low emission vehicle efforts, Vermont has adopted California vehicle emissions standards, which are more stringent than federal standards and also regulate greenhouse gases (VAT, "Vision & Action for Our Heating Future"). Notable progress has also been made on developing electric vehicle technology in the state and building the necessary transportation infrastructure for electric vehicle travel. One initiative in particular, developed this September by the Agency of Natural Resources and the Agency of Commerce and Community Development, invests in developing electric vehicle charging stations in Vermont's downtowns. Since commercially available electric vehicles require multiple hours to fully charge, ANR hopes that providing charging opportunities in towns will encourage electric vehicle use. Governor Shumlin stated, "Making Vermont downtowns electric vehicle-friendly is just another part of our broader strategy to keep these communities strong and vibrant." Additionally, Green Mountain Power also has committed to supporting the widespread adoption of plug-in electric vehicles, and has installed three public charging stations thus far (GMP, "Plug'n Go Stations"). These efforts to reduce transportation emissions—most notably improving fuel efficiency, electric vehicle technology and infrastructure, and public transit—are becoming increasingly important, as the transportation sector is Vermont's fastest growing end-use energy sector, at a rate of 1.3% per year (VT DPS). Similarly to residential costs, transportation costs are dependent on the volatile supply of oil.

Energy Demand

Overall, Vermont's energy demand might be on the edge of decline. The state's energy use has "increased at a 1.8% rate of growth from 1990 to 1999, but has been close to 0% for the past 10 years." On the electric side, consumption has decreased by more than 2% annually, due to advances in efficiency and conservation (VT DPS). Moreover, the state has steadily reduced its emissions—3% per year since 2004 (VT DPS). Given the progress thus far, Vermont seems dedicated to advancing energy efficiency and renewable resources, and capable of instituting change in its energy use and supply. Despite this progress, Vermont still ranks 11th best for total energy consumption per capita. This is among the lowest in the nation, but legislators concur that it could be lower (EIA, "Vermont"). The effort to improve energy efficiency and develop a cleaner energy mix must be multiplied in order for Vermont to serve as a model for other states, and to make a small dent on slowing climate change.

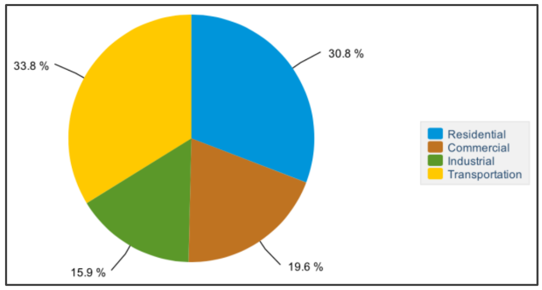

Figure 4. Vermont Energy Consumption by Sector, 2011 (EIA)

This path will involve reducing Vermont's reliance on oil, improving energy efficiency, and increasing the use of clean, renewable, energy in the heating and transportation sectors. It will also involve educating Vermonters on the real savings they will gain through the upfront costs of investing in efficiency and renewable energy. Ideally, transitioning to a low-carbon future will foster economic security and independence, reduce the state's contribution to climate change, and create Vermont-based renewable energy and efficiency businesses and jobs. All of these goals align with Vermonters values of independence, community, and a clean environment.

Current Vermont Energy Statutes and Programs

Long Term Greenhouse Gas and Renewable Energy Targets

Before recommending any new policy options for the state, it is important to briefly review the current programs and policies in place to address energy and climate change concerns. As mentioned earlier in the report, Vermont has already acted—to some extent—upon the demand for long-term energy planning goals and programs. Statutory progress towards establishing greenhouse gas (GHG) regulation in Vermont began in 2006 with the passage of Act 168. This Act set the lofty goal for the state to reduce its GHG emissions by 75% compared to a 1990 baseline level, with checkpoints of 25% in 2012 and 50% in 2028 (RAP 4). Building upon that legislation, the Vermont Department of Public Service (VT DPS) released in 2011 its first Comprehensive Energy Plan since the late 1990s—a document intending to guide Vermont's energy future for the next 20 years. Furthermore, it sets forth another policy recommendation: achieve 90% energy consumption from renewable sources across all sectors of the economy by 2050 (VT DPS). In response to the 2011 Energy Plan, the Vermont legislature passed Act 170 in the 2012 session that established "*Total Renewable Targets*" for the state. To begin, these targets address the supply portfolio of each retail electricity provider in the state, but they echo the goal of the Energy Plan of reaching economy-wide 90% renewable energy consumption. While this 90% target is not binding legislation at this point, the state government is actively pursuing policy formulation.

As a result of Act 170, the legislature recommended that the Vermont Department of Public Service undertake a "Total Energy Study" to formulate an optimum policy and technology mix with the potential to achieve the state's GHG emission and renewable energy goals. The VT DPS initially planned to present the findings of the Total Energy Study process to the legislature in December 2013, but Act 89 of the 2013 session extended the deadline for the report's release. Still, to launch this process, the VT DPS contracted a consultant (the Regulatory Assistance Project) to produce a Framing Report in June 2013. This Report, an exhaustive catalogue of regulatory mechanisms and technologies, aimed to inform those involved in the subsequent stakeholder meetings held in August and September 2013 on the various options available.

According to Asa Hopkins, VT DPS's Director of Energy Policy and Planning, the Department held eleven focus group meetings with a diverse range of stakeholders to assess the feasibility of emissions regulation and renewable energy deployment going forward. In our conversation with Hopkins, he outlined five "policy sets" the Department was pursuing in light of these meetings. He asserted that the Department would not pursue one single approach in the DPS's final Total Energy Report, but rather recommend an optimum mix of these policies. Significant policy sets are as follows:

1. Establishing a "Total Energy Standard": a Renewable Portfolio Standard (RPS) generalized to all sectors
2. Carbon Tax shift: revenue neutral; slash taxes from other areas; ensure it is not regressive
3. Small Carbon Tax: not revenue neutral; fund renewable energy programs
4. Sector Specific Policies: i.e. Electric Supplier RPS; Transportation Vehicle Miles Traveled (VMT)
5. Regional Focus: VT cooperation with existing New England State RPSs to integrate policy and regulation (taking into account regional electric grid and energy supply)

The Total Energy Study is particularly significant in the context of this report because it aims to identify the various ways in which Vermont can achieve its GHG emission target through its energy decisions. While the DPS intends to answer this question through a comprehensive consideration of all available options, this report hopes to answer this question through the narrow lens of the values of Vermonters.

<u>Current Renewable Energy Programs</u>

Alongside the state's push to establish a policy pathway for achieving GHG goals by 2050, Vermont also has in place two important programs encouraging the uptake of low-carbon fuel sources. Therefore, when considering the formulation of large-scale carbon abatement and renewable energy investment in the state, the following programs should also be considered.

<u>Net Energy Metering (NEM)</u>: A program offered by electric utilities in states all across the country, NEM provides a proven approach to incentivizing the installation of renewable energy generation by a utility's customers. In Vermont specifically, NEM establishes that any customer can install a system (from a list of approved generation sources) of 500 kW or less and receive a retail rate credit on their energy bill for the kWh produced by their system during the given month. Since the system remains connected to the utility's electric grid, the customer's final bill is this generation credit balanced out against the energy consumed from

the grid. The exact compensation is calculated based upon the retail rate for that month, plus additional credit in some cases. Despite the program's success—it already reached its 4% cap of total generation in all but a few utilities across the state—challenges within the NEM program were highlighted in an information session at the 2013 Renewable Energy Vermont Conference (Note: these challenges and other aspects of NEM are currently being addresses in the 2014 Legislative Session):

1. Impact on Utilities: Patty Richards of Washington Electric Cooperative is worried about an unjust *cost shift* for its customers, given that fewer individuals pay more for grid upkeep if net-metering customers end up with a net zero energy bill. Furthermore, Washington Electric suggested a reduction in credit for energy generation from NEM devices or a state program to compensate customers, so that credit was not given through the customer's bill with the utility.

2. Financing uncertainty: Luke Shullenberger of Green Lantern Capital highlighted that uncertainty over the "bankability" of certain NEM projects, as well as the 4% program cap, was restricting potential capital flow into more renewable energy development in the state (specifically in projects 10-150 kW in size).

Sustainably Priced Energy Enterprise Development (SPEED) Goals: Vermont's Sustainably Priced Energy Enterprise Development (SPEED) Program was created by legislation in 2005 to promote renewable energy development. While not in name a Renewable Portfolio Standard (RPS), the SPEED program acts very similarly to an RPS. The program established a goal in 2008 that electric utilities generate 20% of energy from renewable sources by 2017. If the minimal obligation is not met, then the Vermont Public Service Board will establish a binding renewable energy portfolio standard. The intent of the SPEED program is to promote renewable energy development by encouraging long-term contracts for electricity from renewable sources. To qualify as a SPEED project, the facility must be located in Vermont and produce energy using renewables. Beginning in 2013, the Public Service Board also established a Standard Offer Program that guarantees a $/kWh compensation for systems up to 2.2 MW.

Current Market-Based Program: RGGI

Any conversation regarding next steps for Vermont's clean energy future must first address the current program in which Vermont is currently involved: the Regional Greenhouse Gas Initiative (RGGI). Operating in the Northeast and Mid-Atlantic states of the U.S., RGGI is the nation's first mandatory, market-based program to reduce emissions of carbon dioxide. RGGI's creation was due largely to the leadership of governors and pressure from environmental groups. As a number of states developed climate change action plans, they recognized that greenhouse gas reductions would be necessary from the power generation sector. This sector includes some of the biggest polluters, and as stationary sources, they are quite easy to regulate. It was concluded that a regional market-based cap-and-trade program for CO_2 was the best option for obtaining such reductions. In 2003, governors from Connecticut, Delaware, Maine, Massachusetts, New Hampshire, New Jersey, New York, Rhode Island, and Vermont commenced discussions to develop a regional cap-and-trade program addressing carbon dioxide emissions from power plants. By 2008, nine states participated in RGGI and established individual rulemaking processes. The program's first compliance period for all state's linked

CO_2 Budget Trading Program occurred on January 1, 2009 (RGGI, Inc., "Program Design and History").

RGGI places a regional cap on the total amount of CO_2 emitted by fossil fuel-fired power plants greater than twenty-five megawatts in size. The policy requires power plants to possess a tradable carbon allowance for each ton of CO_2 they emit. Each RGGI state issues a certain number of CO_2 allowances based on its individual regulations, but the states as a whole put an absolute limit on pollution levels by "capping" the total number of allowances allowed (RGGI, Inc., "About RGGI"). The states auction a fixed quantity of allowances at quarterly intervals, and then power plants can trade allowances. Firms can either purchase surplus allowances from the market or pay for emission reduction measures, which demonstrates how the cap-and-trade approach can cost-effectively reduce emissions. In 2014, the regional CO_2 budget, or "RGGI cap," will decrease from 165 million to 91 million tons—a reduction of 45 percent. The cap will continue to decline 2.5 percent per year, for a total reduction of 10 percent by 2018 (Clean Technica, 2012).

In general, RGGI acts as an effective and practical means of addressing climate change, as it reduces pollution and generates revenue to re-invest in the clean energy economy. Region-wide emissions from power plants in the region have declined 40% from 2005 levels (DEC, "RGGI"). However, many agree the decline in emissions occurred independently from RGGI, and was in fact influenced by the fall in natural gas prices relative to coal and oil. The clear benefit of RGGI lies in the revenue generated by the auctions. Selling allowances, rather than giving them away for free, has generated proceeds of over $1.2 billion to date (RGGI, Inc., "Program Design and History"). These funds have supported various policy objectives, but primarily were used for strategic energy programs. Overall, participating states are collectively investing 63 percent of RGGI auction proceeds in programs to "improve end-use energy efficiency and accelerate the deployment of renewable energy technologies," or other climate-related efforts (RGGI, Inc., "Program Design and History").

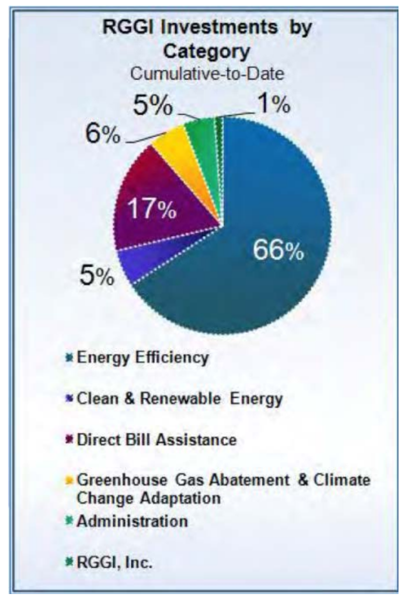

Figure 5. RGGI investments by category (all states) (RGGI)

RGGI investments fall into four primary program categories: energy efficiency, clean and renewable energy, direct bill assistance, and greenhouse gas abatement and climate change adaptation programs. Of particular importance to this report are the direct bill assistance programs. Some RGGI states have returned $69 million in bill credits to 84,000 low-income families. Other states give rate relief to all electricity consumers in the RGGI region through credit on their electricity bill (RGGI, "Allowance Proceeds").

In Vermont in particular, RGGI allowance revenue has been invested in programs that support whole building heating, process energy efficiency, and facilitate appropriate fuel switching. Half of these programs benefit low-income consumers in particular (RGGI, Inc., "Program Design and History"). For example, Vermont invests 58 percent of its CO_2 allowance proceeds in Efficiency Vermont, which works to directly lower energy bills for Vermonters and reduces the state's energy usage as a whole. The success of RGGI thus far in Vermont suggests that market-based carbon abatement programs have the potential to reduce emissions in this state

by placing a value on carbon, coupled with smart investments in renewable and energy efficiency. It is important to note, however, that RGGI could be improved in many ways to drive further reductions in emissions. First, because the program only targets large power producers, its regulations do not cover much of New England's GHG emissions—only about 27% (Farrell and Hanemann). The actual cap only covers CO_2 emissions from fossil-fueled power plants with capacities larger than 25 megawatts, affecting around 225 facilities in the region (Peel). The program also fails to regulate transportation and residential sectors, which represent three-quarters of Vermont's emissions. Vermont is simply not a big manufacturing state; it only has two RGGI regulated budget sources, and contributes just 0.74% of the regional emissions cap (DEC, "RGGI"). The unique energy portfolio of the state suggests that legislators might consider extending RGGI's jurisdiction to cover transportation and heating fuels, or implementing an additional carbon abatement mechanism in the state, such as a carbon tax. To further increase the scope of the program, Stafford Professor of Public Policy, Political Science, and Environmental Studies Christopher Klyza suggested that RGGI could expand to regulate any stationary producer of greenhouse gas, not just large, electricity-producing power plants.

Overall, RGGI represented a major step in advancing climate policy in that it established the foundation for a North American Carbon Market and provided a model for other programs to reduce CO_2 emissions. However, now RGGI must be much more than just a model. Justin Johnson, a representative for Vermont on the board of the Regional Greenhouse Gas Initiative, and one of the original designers of the program, stated in an interview that, "When we first put RGGI together, we did it as a way to push the federal government to start a national cap-and-trade. But now, this *is* the program." Johnson explained the absence of any government momentum toward building a national cap-and-trade program anytime soon, which suggests that RGGI must be as effective as possible on a regional scale, potentially warranting further reforms to the program. Johnson reiterated the importance of investing the revenue in efficiency and renewables, given the small number of regulated sources in Vermont. "The real savings, in Vermont, are not in electric generation per say," he said. "But they're in transportation fuels and heating. We must continue to take the money earned from electric sector and put it into thermal efficiency, where a lot of improvements can be made." Until RGGI is reformed to more significantly reduce regional emissions—which the lowered cap might accomplish in 2014—it seems RGGI will continue to exist primarily as a source of government revenue for re-investment in the clean energy economy. The fact that Vermont is already part of a market-based, carbon abatement, program provides a foundation for further climate policy in the state.

What Now?

Between the Total Energy Study and multiple renewable energy programs, Vermont undoubtedly recognizes the need to change the way it uses and produces energy. Yet, the efforts to achieve these changes still lack bold decisions that would truly put Vermont at the forefront of climate change solutions. Building a clean energy economy will require more than encouraging the development of renewable technology. It will require changing the way carbon is valued. This is where the benefits of an economy-wide mechanism for pricing carbon become clear. Putting a price on carbon could reduce Vermont's contribution to climate change, generate revenue for investment in energy programs, and support the values of the citizens, all of which steer this report toward recommending a market-based carbon abatement mechanism for the state. The following section summarizes a myriad of functioning market-based carbon abatement programs around the world. Our recommendation section then analyzes this research by selecting

qualities of existing mechanisms that could work specifically in Vermont. Moreover, the report explains how this type of climate policy and budgeting structure—if carefully designed—could meet Vermonters' demand for a clean energy economy, while also addressing their concerns about equity and affordability.

VI. Summary Table of Policies

The following table summarizes key components of many functioning market-based carbon abatement mechanisms around the world. The analysis of these mechanisms is undoubtedly important for designing a successful and effective carbon policy in the state of Vermont. See Appendix A: Examples of Market-Based Carbon Abatement Mechanisms for descriptions of each mechanism.

		Overview				Revenue					Industry Regulation			
		Goal	Allocation or Auction?	Start Date	Carbon Price	Resident Comp.[b]	Addresses regressive impact[c]	Carbon Abatement Initaitives[d]	Consumer Comp.[e]	Other	Power Prod.	Transp.	Heating Fuels	Large Industrial Plants
Cap-and-Trade	California	20% by 2020 80% by 2050 rel. to 1990	Auction	2006	$13.62/ permit (Feb. '13)	N	Y	Y	Y	-	Y	Y[1]	Y[1]	Y
	RGGI	-	Auction	2009	$3.00/ permit (Dec. '13)	N	N	Y	N	Revenue distribution in table is specific to VT only	Y	N	N	Y
	ETS	20% by 2020 rel. to 1990	Alloc. phased to Auc.	2005	$8.80/ permit (Jan. '13)	N	N	Y	N	Rev. distrib. decided by member countries, but all countries are required to invest in abatement initiatives	Y	Y[2]	N	Y
Carbon Tax	Sweden	-	-	1991	$150/t (since '97)	N	Y	N	N	All revenue is deposited into general government fund	N	Y	Y	Y[3]
	British Columbia	Reduce emissions 3 MM tCO_2/y by 2020	-	2008	$30/t (since '12)	N	Y	N	N	Tax is revenue neutral	All Fossil Fuels			
	Australia	5% by 2020 80% by 2050 rel. to 2000	-	2011	$24/t (since '12)	N	Y	Y	N	Portion of rev. goes towards low carbon R&D	Y	N	N	Y
	France	-	-	2014	7 €/t (starting in '14)	Revenue distribution still in development stages					All Fossil Fuels			

[b]Resident compensation is paid to residents of a region regardless of emissions or income

[c]Compensates low-income families that may be disproportionately impacted by additional carbon-related expenses

[d]Carbon Abatement Initiates fund projects such as renewable energy, energy efficiency and transportation infrastructure, for example

[e]Consumer Compensation allocates revenue towards consumers or rate payers in order to lessen the financial burden of carbon expenses

[1]Transportation and Heating fuels will be regulated in California starting in 2015

[2]Domestic Airlines only

[3]Large industrial plants pay only half of the carbon tax rate

VII. Policy Recommendations for Vermont

In this policy recommendation, we aim to answer two main questions surrounding market-based carbon abatement mechanisms: first, what industries should be regulated, and second, how is the revenue from these mechanisms allocated? From an economics perspective it does not matter which type of market-based mechanism is implemented in the state of Vermont, whether it be a modified RGGI or a new carbon tax. Since both types of mechanisms represent the least cost path to pollution control, our recommendation for industry regulation and revenue allocation remains the same (See Appendix A: Theoretical Framework, *Tietenberg and Hanley on Cost-Effective Pollution Control*). We designed this proposal to address the issues in Vermont's unique emissions portfolio, and to incorporate Vermonters' specific values and concerns. This section does not provide comprehensive information on details such as a definitive price or emissions cap, revenue generation estimations, or a price stabilizing mechanism, for example. Details such as these were left out primarily because they will be subject to extensive empirical research as well as political compromise. This section discusses industry regulation and revenue distribution by drawing on Vermonters' values, as well as research from other carbon capping or pricing mechanisms around the world (See Appendix B: Examples of Market-Based Carbon Abatement Mechanisms and Section VI: Summary Table of Policies). This recommendation has two main goals: first, to instigate discussion in the state of Vermont surrounding carbon abatement, and second, to illustrate how market-based mechanisms mesh or coincided with Vermonters' values.

Industry Regulation

The major industries regulated would include power production, transportation fuels, heating fuels and other large polluting industries. As of 2010, transportation and heating fuels contributed roughly 80% of Vermont's emissions; therefore, the regulation of these two industries may be critical for Vermont in order to reach its carbon abatement goals. Power production, commercial, and industrial emissions comprise Vermont's remaining carbon emissions (Brown, "Emissions by Sector").

Ease of regulation varies from industry to industry. Regulation of power production, for example, is fairly straightforward and inexpensive primarily because emission sources are often widely dispersed but few in number. Large power producing entities simply purchase pollution permits or pay an incremental tax relative to their emissions. The regulation of heating and transportation fuels, however, is inherently more difficult due to the nature of the industries. Regulating transportation or heating fuels downstream (e.g., the final point of consumption or at the household level) means that emissions sources are numerous, widely dispersed and costly to monitor. In contrast, regulating upstream (e.g., the point of production, oil field or port) means emissions sources are far more concentrated, but many of these production companies are located outside of the state or even outside of the country. The point at which carbon emissions are regulated in the energy system poses large implications for transactions and monitoring costs **(**Ellerman *et al.*). These problems pertaining to monitoring and transactions costs have been dealt with in a number of different ways.

California, for example, is scheduled to implement phase II of their cap-and-trade mechanism by 2015, which would impose additional carbon-related expenses to heating and transportation fuel distributors. In other words, these heating and transportation fuels would be subject to additional costs at the wholesale price.

The most plausible method of transportation and heating fuel regulation in Vermont would be to regulate relatively upstream entities. Similar to California, this would mean that fuel distributors, such as Champlain Valley Plumbing and Heating and Mike's Fuels, for example, would be subject to purchasing carbon emission permits or paying a carbon tax proportional to the quantity of carbon present in their fuel sales. The possibility of Vermont leading the way towards the regulation of the transportation and heating fuels industries is a prime opportunity for Vermont to serve as a model for not only other RGGI member states, but also other states around the country.

Revenue Allocation

One major question that arises once a cap-and-trade or carbon tax mechanisms is implemented is what policy makers should do with the revenue. Assuming Vermont collects all cap-and-trade or carbon tax revenue, we recommend distributing this revenue into three Funds:

- Fund I: Carbon Abatement Fund
- Fund II: Regressive Dividend
- Fund III: Vermont Resident Dividend

Fund I would demand a portion of revenue proceeds be deposited into a General Carbon Abatement Fund. This general fund would be eligible for use through application. Various state governmental departments would be eligible to apply for funding if they produce a compelling reason for fund usage. For example, these carbon abatement funds could be used to finance renewable energy projects, energy efficiency improvements or energy infrastructure. The goal of the Carbon Abatement Fund would be to prioritize the cheapest means of carbon abatement. In other words, funds are allocated to the lowest hanging fruits first.

This type of fund follows the example of the existing Working Lands Enterprise Fund in Vermont, which offers monetary awards to selected recipients working on improving the agricultural sector of the economy. This Initiative was based upon the findings of the Council on the Future of Vermont and demonstrates the ability of the state to pass policy and budgeting measures in support of Vermonters' values.

As previously mentioned in Section III (The Voices of Vermonters), state residents today rank alternative and renewable energy issues as one of the top five most important issues in the state of Vermont, with 56% of poll respondents claiming they were **"**very concerned" about Vermont's energy future **(**Moser *et al.*, 16**)**. The benefits of a Carbon Abatement Fund could meet Vermonters' demand for energy improvements and play a major role in increasing the amount of renewable energy, energy efficiency and renewable energy infrastructure in the state of Vermont.

This type of Carbon Abatement Fund is already in use in California, for example. Around 75% of the revenue raised from industrial and transportation sector regulation is used to fund the state's clean energy goals. These General Abatement Funds are additionally utilized in Europe's Emissions Trading Scheme (ETS), Australia's carbon tax and France's carbon tax.

Fund II proceeds would go towards a Regressive Dividend, which would be used to address the regressive impact of additional carbon expenses. Carbon capping or pricing mechanisms impose additional costs to all families; however, these additional costs impact families in different ways. Carbon expenses, for example, represent a larger portion of lower income families' budgets than for higher income families.

Affordability and cost of living, also mentioned in Section III, are two major concerns for Vermonters. As a result, this Regressive Dividend would be paid to low income families on an annual basis to lessen the burden of additional carbon expenses on many families that are already having difficulty meeting the cost of living. In the 2012 calendar year, there were about 162,000 income earning families residing in Vermont. These families have annual incomes ranging from several thousands of dollars to millions. Roughly 25%, or around 40,000 Vermont families, earn less than $40K/y (U.S. Census Bureau). We recommend allocating a portion of the mechanism's revenue towards Vermont's lowest earning quartile. These family constituents would be directly compensated as a function of their income (Figure 7).

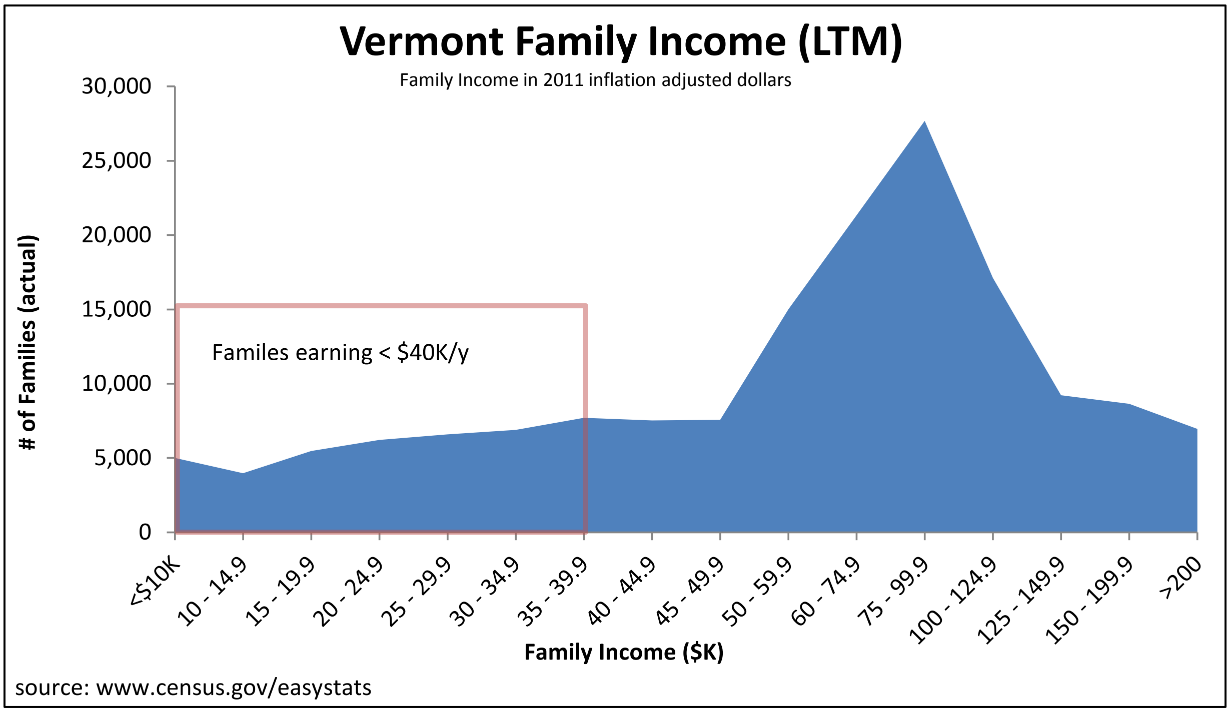

Figure 7. Vermont Family Income

Both California and Australia pay a similar Regressive Dividend to low income families. Australia allocates 50% of its carbon tax revenue towards household assistance, particularly low-income households, through tax breaks and other tax reforms (See Appendix B: Examples of Market-Based Carbon Abatement Mechanisms, *Australia*). Similarly, California allocates around 25% of transportation and industrial regulation proceeds towards low-income families that may be disproportionately impacted by the state's cap-and-trade mechanism (See Appendix B: Examples of Market-Based Carbon Abatement Mechanisms, *California*).

Fund III revenue would be distributed in the form of a Vermont Resident Dividend. This Resident Dividend would be equally distributed on an annual basis to each Vermont resident irrespective of their emissions or income. The only requirement for this Resident Dividend is that an individual possesses Vermont residency for over a calendar year.

Peter Barnes suggests thinking of this Resident Dividend in two ways. First as a "civic institution" and second as a "scarcity recycling mechanism." As constituents of various townships, counties and states we are all entitled to equal ownership of these entities' civic

institutions such as public libraries, schools and town or city halls, for example. As a result of this common ownership we are also entitled to an equal share of the common benefits from these institutions: schooling, library books and common meeting space. Similar to the ownership and corresponding benefits associated with schools and libraries, a Resident Dividend symbolizes the common ownership of our atmosphere (Barnes, 62-63). As a result of this common ownership we are also entitlement to the common benefits or proceeds of this communal asset. These benefits are manifested in the form of a dividend paid to Vermont constituents.

Barnes also suggests thinking about this Resident Dividend as a "scarcity recycling mechanism: [w]e, the users, pay scarcity rent for the sky because—well, because it's scarce" (Barnes 64). The sky's ability to absorb carbon is and should be a valued asset in our society and because the atmosphere has a limited carbon storage capacity, individuals must pay to pollute. "We, the owners, then get back our share of the scarcity rent because—well, because we're the owners" (Barnes 64).

Although there are few market-based carbon abatement mechanisms around the world that utilize a Resident Dividend in their policy, this dividend serves a similar objective as a dividend currently distributed within the United States that many American's are familiar with: The Alaska Permanent Fund Dividend (See Appendix C: Other, *Alaska Permanent Fund*).

A Resident Dividend, additionally, has a progressive impact. All residents receive the same Resident Dividend annually; however, not all residents pay the same amount. Wealthier individuals pay more, in terms of carbon related expenses, by powering and heating larger homes and driving larger cars. A study conducted by the Congressional Budget Office in 2000 concluded that if a national cap-and-trade mechanism were implemented with a Resident Dividend that the bottom 40% of the populace would benefit, the middle 20% would break even and the top 40% would lose (Congressional Budget Office; Barnes, 65). The progressive nature of this Resident Dividend would continue to address the concerns of Vermonters' pertaining to affordability and cost of living in the state.

Through addressing the matters of industry regulation and revenue allocation, this policy provides the framework for a market-based carbon abatement mechanism, whether it is a tax or a cap, that could potentially target the emissions sectors of Vermont that are most significantly contributing to climate change, while ensuring that the initiative's goals take into consideration Vermonters' concerns and values.

VIII. Conclusion

The residents, businesses, academics and legislators that contributed to this report vocalized at least one common theme: Vermont is unique. Most Vermonters would agree that the state has a unique environment, economy, sense of community, spirit of independence, and willingness to act upon problems that are larger than the state. Climate change is significantly larger than the state, but the scope of the issue does not prevent residents from wanting to take a stab at leadership. Vermonters have a rare connection to the natural landscape, as well as an appreciation for the economic vitality it provides for Vermont. They want to ensure that future generations get an equal chance to enjoy the benefits of living in this state, and many recognize that their dependence on oil to heat their homes and drive to work threatens that prospect. Accordingly, Vermonters have called for state-level changes to reduce their contribution to climate change, primarily by transitioning toward an economy based on clean, renewable, affordable, energy. This report utilizes the policies and experiences of other countries around the

world to propose a market-based carbon abatement solution that could feasibly reduce the emissions of Vermont. Our hope is that in a matter of years, other states will be modeling their emissions decisions around Vermont’s innovative approach to climate change policy and budgeting.

IX. Companion Video

The above report presents a holistic justification for the expansion of market-based carbon regulation in Vermont. The written portion of our research is complemented by a short companion video that aims to introduce the viewer to a range of viewpoints from Vermonters involved in shaping the state's energy future. This video includes selections from in-person interviews with high-level policymakers, business leaders, and members of non-governmental organizations—all of whom offer valuable perspectives for viewers to consider. The goal of the video is to 1) inform Vermonters about the implications of our shared energy on the future health and success of the state, and 2) engage the viewer in the ongoing policy process. The short video can be found on YouTube at the below link and as part of a display at the Vermont Folklife Center in Middlebury, VT in 2014:

http://www.youtube.com/watch?v=h6KPRwxoXlk&feature=youtu.be

Appendix A: Theoretical Framework

Allocation vs. Auction

A cap-and-trade mechanism can either auction carbon permits or give carbon permits away for free. The auction option allows the government to sell permits and collect the proceeds. The allocation option requires the government to determine to whom they should give permits—free of charge—and also how many permits the regulated entities should receive. The allocation option is oftentimes criticized for imposing an information burden on government (Tietenberg, 30-31). As a result, cap-and-trade mechanisms around the world appear to gravitate towards the permit auction option: California, RGGI and Europe's ETS all prefer auction over allocation.

Alternatives to Market-Based Abatement Mechanisms

Command and Control (CAC) policies are an alternative to market-based pollution control solutions. A Technology Standard is one type of CAC policy that requires an entire industry to install a specific technology—smoke stack scrubbers on coal-fueled power plants, for example. Instances where the government mandates a certain technology in a specific industry can limit individual firms' ability to pursue the least cost path towards pollution control. If the goal for an industry is to control pollution in a cost-effective manner then CAC technologies do not always produce a cost-effective outcome (Econport, "Handbook"). A Technology Standard requires the installation of a specific technology; however, a Technology Standard does not encourage individual firms to consider other forms of inexpensive carbon abatement such as energy efficiency or carbon offsets, for example. The least cost path towards carbon abatement can often times be a combination strategy (Muller). A Technology Standard prevents these types of combination strategies by favoring a single technology and this favored technology, again, is not always cost-effective at controlling pollution.

CAC policies are most widely criticized for the information burden they place on the regulating entity. In order for the regulating entity to impose a CAC policy it requires vast amounts of information on the costs and benefits of pollution abatement strategies—which are constantly changing—in addition to detailed information on firm's individual cost structures within the target industry. CAC policies are often favored in instances where quick response is required or in other words, where the health hazards of a pollutant are prioritized over the cost-effective abatement of the pollution (Econport, "Handbook").

As mentioned in Section V (Energy in Vermont: The Current Picture) the Sustainably Priced Energy Enterprise Development (SPEED) Program is a renewable portfolio standard (RPS) requiring Vermont utilities to generate 20% of their energy from renewables by 2017. Just as a Technology Standard favors a specific technology (smoke stack scrubbers, for example) an RPS favors a set of technologies (in this case, renewable energy technologies). If the goal of the state is to abate carbon in a cost-effective manner then an RPS such as SPEED favors a set of technologies and does not incentivize firms to pursue the least cost path towards pollution control. This least cost path may consist of a combination of strategies such as energy efficiency improvements or carbon offset projects. An RPS is not necessarily considered cost-effective in the context of carbon abatement.

Tietenberg and Hanley on Cost-Effective Pollution Control

Tom Tietenberg describes the cost-effective nature of cap-and-trade mechanisms in his book *Emissions Trading*: “Plants have very different costs of controlling emissions. When credits are transferable, those plants that can control most cheaply find it in their interest to control a higher percentage of their emissions because they can sell the excess. Buyers for these reductions can be found whenever it is cheaper to buy emission reduction credits for use at a particular plant than to install more control equipment. Whenever an allocation of control responsibility is not cost-effective, further opportunities for trade exist. When all such opportunities have been fully exploited, the allocation is cost-effective” (Tietenberg, 16).

Very similarly, Nick Hanley et al. describe the cost-effective nature of carbon taxes, or more generally speaking “charges on pollution,” in their book *Environmental Economics*: “In principle, by charging for every unit of pollution released into the environment they [tax on pollutants] induce firms to lower their emissions to the point where the incremental cost of pollution control equals the emission charges they must otherwise pay. Because pollution control costs typically differ among producers, those with lower control costs will tend to reduce their emission levels further than will higher-cost polluters. Emission charges give producers an incentive to develop and adopt newer and better pollution control technologies as a means of bringing down the charges they must pay. To the degree that individual polluters use pollution control strategies which represent least cost solutions, the aggregate costs of pollution control should be minimized” (Hanley *et al*., 61).

Definitive Emissions Reduction

A major benefit of an emissions cap is that it makes definitive emission reduction goals very easy to measure. California’s cap-and-trade policy, for example, outlines emission reduction goals of 20% by 2020 and 80% by 2050 relative to 1990 levels. In other words, carbon budgeting is very easy to follow and track with a cap-and-trade mechanism.

Carbon budgeting, however, is more difficult with a carbon tax. Since a carbon tax caps price and lets the markets determine the quantity of CO_2 emitted, the nature of the mechanism makes it inherently difficult to budget certain amounts of carbon by certain dates. Quotas are a tool that can be used to assist carbon tax mechanisms in achieving definitive abatement goals. A quota can be set as quantity ceiling. This quantity ceiling represents the maximum amount of carbon that can be emitted over a given time period. A carbon tax with a quota is capable of achieving abatement goals; however, the more aggressive the quota is, the more the carbon tax starts to look like a cap-and-trade mechanism (Muller).

Price Volatility

Although cap-and-trade mechanisms are great for meeting emission reduction goals, they are more exposed to price volatility. Because a cap-and-trade mechanism caps quantity and lets the market determine the price of carbon, these carbon prices can be subject to unpredictable and noisy behavior. Price volatility can be detrimental to businesses if they are faced with high variable costs. Price collars are an effective means of dealing with price volatility. A price collar sets a price floor and a price ceiling for carbon allowing the price only to fluctuate within a smaller range of values. Price collars are meant to protect industry from price volatility. The looser the price collar the more exposed industry is to price volatility; however, the tighter a price collar is the more a cap-and-trade mechanism starts to look like a carbon tax (Muller).

A major benefit of a carbon tax is that price volatility is not an issue. A carbon tax eliminates concerns over price volatility by setting a fixed price on carbon. With fixed carbon prices businesses can much more easily factor their carbon related costs into their operating models, and minimize their volatility risk

Appendix B: Global Carbon Abatement Mechanisms

British Columbia Carbon Tax

- *Goal*: British Columbia introduced its first carbon mechanism, a tax, in 2008. The tax is intentionally broadly based, paid by all consumers of fossil fuels in the province (Abraham and Nuccitelli).
- *Pricing*: The initial price was set at $10 per ton of carbon dioxide, set to rise annually in $5 increments until it reached $30 per ton of carbon dioxide in 2012 (Ministry of Finance, "Carbon Tax Review"). The current price of carbon is $30 per ton and generates $1.2 billion per year (Abraham and Nuccitelli).
- *Regulated Industries*: The BC carbon tax regulates the fossil fuel industry. The tax has fallen heaviest on industries with high emissions intensities such as cement production, petroleum refining, and oil and gas extraction (Ministry of Finance, "Carbon Tax Review"). Since July 2008, British Columbia's fuel consumption has fallen by 17.4% per capita, and by 18.8% relative to the rest of Canada (Sustainable Prosperity, "BC's Carbon Shift After 5 Years").
- *Revenue*: The tax is revenue neutral, meaning that all proceeds collected by the government are returned to businesses and individuals as tax cuts and rebates instead of funding other government programs (Ministry of Finance, "Carbon Tax Review"). This shift has benefited taxpayers; British Columbia currently boasts Canada's lowest income tax rates. Most importantly, the province has not been placed at an economic disadvantage as a result of the tax. From 2008 to 2011, GDP per capita in BC was on par with the rest of Canada (Abraham and Nuccitelli).

Australia Carbon Tax

- *Goal*: The Australian Carbon Pricing Mechanism was passed by the 27th Prime Minister Julia Gillard in 2011 as a part of her Clean Energy Bill (Clean Energy Regulator, "Carbon Pricing Mechanism"). It was a proactive attempt on Gillard's part to assist Australia in its goal of reducing emissions by 5% below the 2000 level by 2020 and 80% below the 2000 level by 2050.
- *Pricing*: The mechanism calls for a fixed price period from 2012-2015 and then a flexible price period thereafter. The regulated firms were required to pay $23/ton from 2012-2013, $24/ton from 2013-2014, and will be required to pay $25.40/ton from 2014-2015 (Kossoy *et al*.).
- *Regulated Industries*: The carbon price is placed on firms that directly emit more than 25,000 tons per year. These include Australia's larger electricity plants and industrial plants. In fact, the only sectors that emit above this threshold that are *not* regulated are agriculture and transportation. To emit, these industries must purchase credits equivalent to their emissions rate at a set price per permit. Industries regulated will not change or expand for 2014-2015 (Kossoy *et al.*).
- *Revenue*: From 2012-2013, the mechanism raised $7,988,500 million in revenue and recycled roughly $7,602,500 million of those proceeds (Kossoy *et al.*). To fight the regressive nature of the tax, over 50% of the revenue from the carbon price is returned to households, prioritizing low-income homes, rural populations, pensioners, retired citizens, and "vulnerable energy users (Clean Energy Regulator, "Carbon Pricing Mechanism"). This occurs either through tax relief or increased family benefit payments:

parallel tax cuts, a higher Family Tax Benefit (payments given to parents of dependents), increased tax-free thresholds for low- and middle-income households, increases in pensions, direct family grants, or allowances (Kossoy *et al.*). The rest of the revenue is used to assist industries and workers that are most affected by trade-exposed activity, and to increase investments in renewable energy, other energy efficient activities, and low carbon related research and development (Kossoy *et al.*).

- *Application to VT*: The mechanism as a whole is a helpful example for Vermont. Australia's government utilizes the tax revenue in two very important ways: making a return to consumers while also investing in the renewable sector, which creates an incentive to shift away from fossil fuels and greenhouse gasses.

California Cap-and-Trade

- *Goal*: California's cap-and-trade, also known as AB32 or the Global Warming Solutions Act, was initially signed into effect by Arnold Schwarzenegger in 2006 with the goal of reducing GHG emissions 20% by 2020 and 80% by 2050 relative to 1990 levels. AB32 regulates roughly 85% of California's GHG emission sources.
- *Auctions*: California has currently held two auctions—one in November 2012 and the second in February 2013. During the first and second auctions 23MM and 13MM permits were sold at a market clearing price of $10.09/Met and $13.62/Met respectively (CEPA, "Auction Information"). The November 2012 and February 2013 auctions, additionally raised $54 and $84MM in revenue respectively (Reuters). Auctions occur four times per year—February, May, August and November and there is a price floor set initially at $10/ton and increasing by 5% per year plus inflation (CEPA, "Auction Information"; Kossoy *et al.*).
- *Regulated Industries*: AB32 is broken down into two phases. Phase one requires generating utilities, electricity importers and industrial facilities exceeding 25,000Met of CO_2/year to comply with AB32, which is currently in effect. Starting in 2015, phase two will expand AB32's purview into transportation fuels—natural gas included. The entities that must comply with phase two of AB32 are the upstream fuel providers or essentially the fuel distributers (Katten).
- *Revenue*: California has not yet spent any auction proceeds; however, they plan on having auction revenue go into two buckets. First, a portion of the auction money will go to investor-owned utilities like PG&E and Southern California Edison. Proceeds from the auction are given to those utilities' ratepayers. The California Public Utilities Commission, for example, has proposed giving residential ratepayers a $30 climate dividend bi-yearly. The second bucket includes proceeds from the industrial and transportation sectors. These funds are deposited and used to fund the state's clean energy goals. There was, additionally, legislation passed in September 2012 that requires 25% of the second bucket proceeds to benefit the low-income families that may be disproportionately impacted by AB32 (Hull).
- *Application to VT:* California shares a similar political environment and structure at both the state and national level, which may be a useful model for Vermont and other states around the country. Specifically, the RGGI cap-and-trade program that is already in place in Vermont could be improved by incorporating California's strategies for fighting the regressive nature of the mechanism.

European Union Emissions Trading Scheme

- *Goal*: As a way to meet the carbon-use reductions set by the Kyoto Protocol, the European Union Emissions Trading Scheme was created as the first and largest emissions trading scheme in the world (UNFCCC, "International Emissions Trading"). The overall goal is a 20% reduction below 1990 emissions levels by 2020 (the end of phase III). The EU ETS works towards this goal by building its cap-and-trade mechanism phase by phase, improving on areas as weaknesses are discovered.
- *Allocation and Auctions:* Phase I was implemented from 2005 to 2007 as a "learning by doing" phase. Too many allocations caused the price of carbon to drop to zero in 2007 (European Commission, "EU ETS"). Phase II, which ran from 2008 to 2012, was plagued by a period of economic downturn. The subsequent reduced demand in emissions led to a surplus of unused allowances (European Commission, "EU ETS"). The third trading period began in 2013 and has seen major reform. One of the most important changes is a tighter EU-wide cap on emissions that will reduce by 1.74% each year. Furthermore, there will be an important shift from cost-free permit allocation to auctioning, meaning that the ETS will begin to generate revenue (See Appendix A: Theoretical Framework, *Auction vs. Allocation*). In 2013, 40% of permits will be auctioned, and this number will increase every year. The projected price of carbon for 2014 is €22-30 per ton of carbon dioxide.
- *Regulated Industries:* ETS regulates the greenhouse gas emissions of refineries, power plants, cement production, aviation and other large emitters in the now 31 participating countries (European Commission, "EU ETS"). Businesses are required to monitor and report their ETS emissions for each year, and also must surrender enough allowances to cover these emissions.
- *Revenue*: For the phase that began in 2013, a portion of the revenue will go towards promoting low-carbon investment in Europe, specifically by co-financing the construction and operation of large-scale demonstration projects in the areas of carbon capture and storage and renewable energy technologies (European Commission, "EU ETS"). This is expected to help eliminate costs associated with the program.

Sweden Carbon Tax

- *Goal*: Sweden instituted a carbon tax in 1991, making it one of the first countries to ever do so (Fouché). The state has no specific emissions reductions targets due to the nature of the mechanism (See Appendix A: Theoretical Framework, *Definitive Emissions Reduction*).
- *Pricing*: The tax rate is significant in comparison to other carbon taxes around the world. In 1991 the tax started at a rate of $100 per metric ton emitted. In 1997 this was raised to $150 per metric ton, which continues to be the price of carbon in Sweden today. On top of the Carbon-specific tax, Swedes also pay an additional energy tax on fossil fuels (with petrol heavily taxed at $1.34/gallon) and electricity consumption tax (varying by source between 1.2 and 1.7 cents per kWh consumed).
- *Regulated Industries*: A significant aspect of the regime is that the Swedish government allows steep tax cuts for both industry and electricity producers. The country does not levy any carbon, electricity consumption or energy taxes on electricity generators and only taxes industrial producers at 50% of the full carbon tax rate. In theory, this is done to reduce the tax burden on internationally competitive industries. In practice, this puts more

of the tax burden on the consumer (particularly via high gasoline prices and the electricity consumption tax) and incentivizes industry to continue polluting at the same rate (Johansson).

- *Revenue*: The revenue from the taxes is not earmarked for specific purposes (save for some assistance to low-income consumers) and is returned to the general government fund (Johansson). In 2006, the Swedish government collected almost $10 billion in revenue from the CO_2 and energy taxes combined (Swedish Tax Agency). This regulatory regime by many accounts has brought about its intended impact, as between 1990-2006 the Nordic country cut its emissions by 9% while still enjoying 44% economic growth over that same time (Fouché).
- *Application to VT*: It will be important for Vermont to consider the ability for a regional cap-and-trade system to coexist with a national carbon tax. Sweden is an excellent example of a country whose carbon tax has succeeded under the ETS, a widespread cap-and-trade initiative. Sweden's carbon price is extremely high, and therefore the country is one of the few in the world already very close to relying strictly on renewables.

France Carbon Tax

- *Goals*: The French government first announced the possibility of a national carbon tax in 2009, but it was eventually blocked by the French Constitutional Council 20 days before it was to be implemented. Four years later, Prime Minister Jean-Marc Ayrault has re-opened the case, and a carbon tax will be implemented in January of 2014 (Patel).
- *Pricing*: The initial 2009 tax was to begin at €17 per ton of carbon dioxide. However, the new tax is set to be implemented at a lower rate of €7 per ton of carbon dioxide (Urciuolo). In 2015 it will more than double to €14.5 per ton, followed by another increase in 2016 to €22 per ton.
- *Regulated Industries*: The tax will affect individual consumers and businesses, including nuclear plants (Patel). Direct levies will be imposed on gas and coal, and the consumer will be directly affected.
- *Revenue*: According to one source, €3 billion in revenue will go towards financing the reduction of employment costs while another €1 billion will go towards energy restructuring in social housing (Urciuolo).
- *Application to VT*: France is a promising example of a country that plans to implement a carbon tax under an already existing cap-and-trade mechanism. Though the tax will not start at a level as high as Sweden's, its revenue will be utilized to offset the regressive nature of the tax while also supporting the clean energy sector for businesses and households.

These important cases demonstrate that it is possible to implement a successful carbon mechanism in varying political environments. Even with RGGI in place, Vermont should not be deterred from implementing a tax. In fact, a carbon tax should work alongside RGGI to reduce emissions in a different sector, contributing to Vermont's fight against climate change without hindering the state economically. Otherwise, an expansion of the already existing RGGI program could also benefit the state. Whether it be cap-and-trade or carbon tax, the most important considerations in designing the program will be (1) the sectors regulated and (2) the placement of the revenue. Overall, Vermont's future carbon abatement plan should be designed with the successes and failures of these various carbon reduction strategies in mind.

Appendix C: Other

Alaska Permanent Fund

Since 1976, the Alaskan government has set aside at least 25% of mineral-derived government revenue—mineral lease rentals and royalties from petroleum, for example (APFC, "Annual Dividend Payouts"). These revenues are then invested, and proceeds from this fund are distributed annually to any Alaskan with state residency extending beyond a full calendar year. Since the fund's inception, the fund's annual dividend payments have ranged from $331 to $2069. In the last four years, including 2013, Alaskan residents have averaged a $1058 annual dividend (APFC, "Annual Dividend Payouts"). The goal of the fund is to make sure that current and future Alaskan constituents benefit and continue to benefit from the exploitation of the state's mineral resources (ADR, "Basic Eligibility Requirements"). Similarly, a Resident Dividend could be paid to Vermont constituents in order to ensure that they benefit from the state's exploitation of the sky as a carbon storing resource.

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